BARDEN

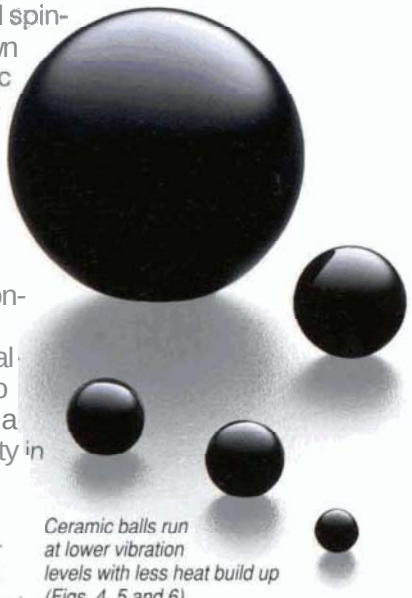
Ceramic Hybrid Precision Ball Bearings

BARDEN
PRECISION
BEARINGS

Ceramic Hybrids: Clearly Superior

While some bearing companies still talkabout the benefits of ceramic hybrid ball bearings, Barden is proving their worth on the factory floor every day.

After years of rigorous testing under a variety of actual operating conditions we decided to replace conventional steel ball spindie bearings in our own machines with ceramic hybrids (silicon nitride balls, steel inner and outer rings). The results have led us to draw one simple conclusion: Ceramic hybrids outperform conventional steel ball bearings so dramatically that their use can no longer be considered a "luxury" but a necessity in many applications.



Ceramic balls run at lower vibration levels with less heat build up (Figs. 4, 5 and 6).

During our evaluation period we discovered that every single spindle tested exhibited vibration levels two to seven times lower when run with ceramic hybrids (Fig. 6). With conventional steel bearings, tolerances were harder to maintain and tool life was shorter.

Barden machines also experienced:

Better workpiece finish characteristics (Fig. 8)

A doubling of diamond cutting tool life

- Overall improved accuracy and reduced scrap rates.

While tests showed that individual spindle performance varied by type, the potential benefits that are possible with ceramic hybrids include:

- Extending bearing service life two to five times longer than conventional steel ball bearings (Fig. 7)

Ceramic hybrid bearings run 50% faster and last two to five times longer than steel ball bearings (Figs. 3, 7).

- Achieving running speeds up to 55% higher resulting in reduced cycle times (Fig. 3)

Increasing productivity through faster acceleration and deceleration boosting metal cutting time, reducing down time.

Because of the unique properties of silicon nitride (Fig. 9), ceramic balls drastically reduce the predominant cause of surface wear in conventional bearings

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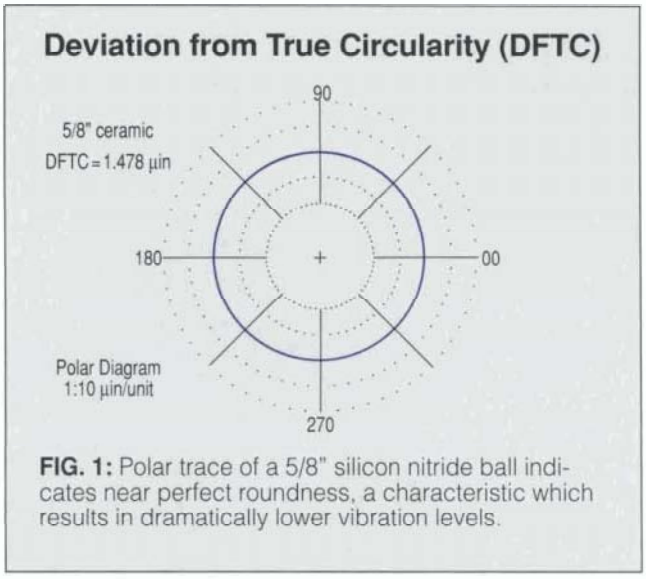

FIG. 1: Polar trace of a 5/8" silicon nitride ball indicates near perfect roundness, a characteristic which results in dramatically lower vibration levels.

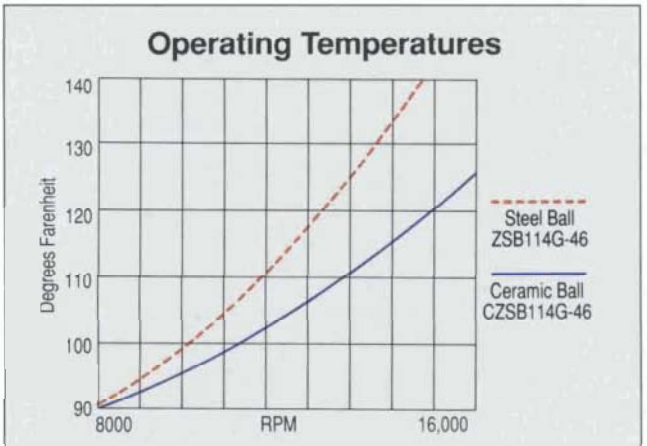

FIG. 4: As running speeds increase, ceramic balls will always, run cooler than conventional steel balls. With reduced heat build up, lubricant life is prolonged.

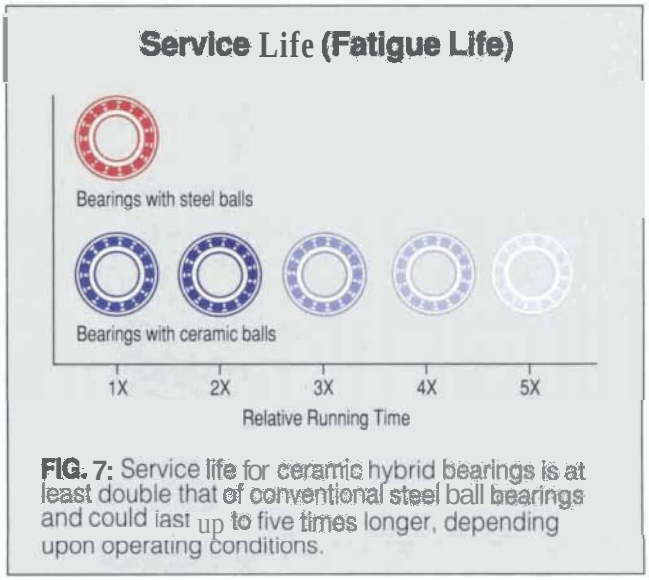

FIG. 7: Service life for ceramic hybrid bearings is at least double that of conventional steel ball bearings and could last up to five times longer, depending upon operating conditions.

Surface Finish of Silicon Nitride Balls

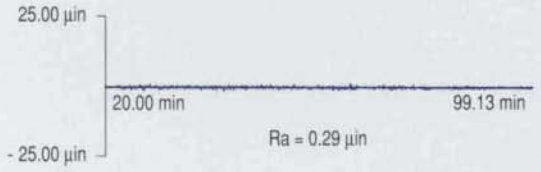

FIG. 2: Finish of a ceramic ball, as expressed in this Form Talysurf trace, reveals a surface that is almost perfectly smooth.

Running Speeds

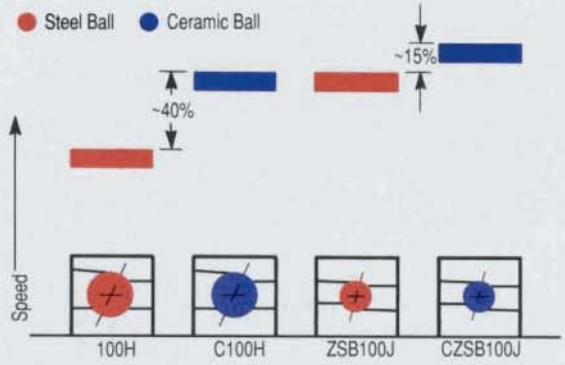

FIG. 3: Running speed of large diameter ceramic ball exceeds same-size steel ball by 40%. Converting to a small diameter ceramic ball will boost running speeds an additional 15%.

Higher Rigidity and Natural Frequency

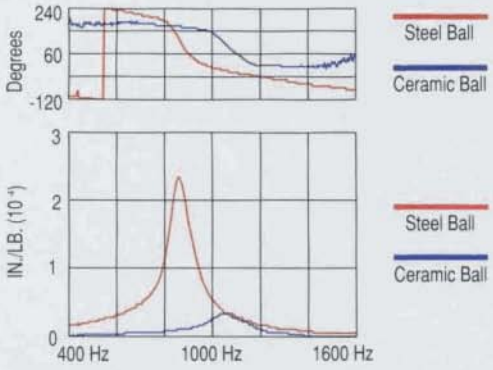

FIG. 5: Dynamic stiffness analysis performed before/after grinding spindle rebuilding shows higher rigidity and higher natural frequency for hybrid bearings, making them less sensitive to vibration.

Vibration

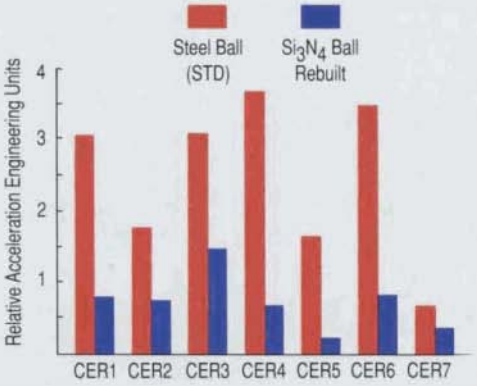

FIG. 6 Vibration tests comparing spindles with steel ball bearings and the same spindle retrofit with ceramic hybrids. Vibration levels averaged two to seven times lower with silicon nitride balls.

Workpiece Surface Finish/Geometry

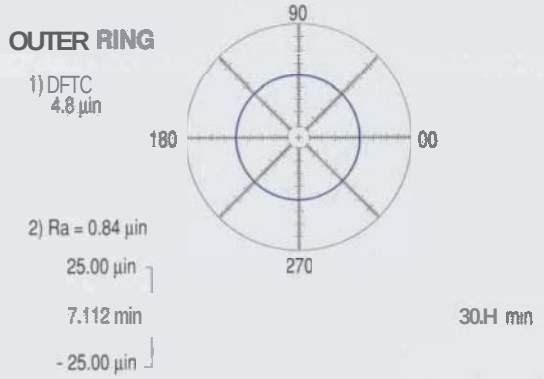

FIG. 8: Ceramic hybrids improve spindle rigidity resulting in greater accuracy and enhanced workpiece finish characteristics, Form Talysurf traces show high degree of precision in finished part.

Comparison of Bearing Steel and Silicon Nitride Properties

FIG. 9:

Property		Steel	Ceramic
Density	(g/cm^3)	7.8	32
Elastic Modulus	(10^6 psi)	30	45
Hardness		R_c60	R_c78
Coefficient of thermal expansion	(X10 $^{-6}$/°F)	6.7	1.7
Coefficient of friction		0.42 dry	0.17 dry
Poisson's ratio		0.3	0.26
Maximum Use Temperature	(°F)	620	2,000
Chemically Inert		No	Yes
Electrically Non-Conductive		No	Yes
Non-Magnetic		No	Yes

(metal rings/metal balls) In conventional bearings. microscopic surface asperities on balls and races will "cold weld" or stick together even under normal lubrication and load conditions. As the bearing rotates, the microscopic cold welds break, producing roughness and, eventually. worn contact surfaces. This "stick-pull" characteristic is known as adhesive wear. Since ceramic balls will not cold weld to steel rings, wear is dramatically reduced Because wear particles generated by adhesive wear are not present in ceramic hybrids, lubricant life is prolonged. The savings in reduced maintenance costs alone can be significant.

A higher modulus of elasticity also means an improvement in spindle rigidity (Fig. 5). This can dramatically improve vibration characteristics.

Optimizing spindle performance, boosting productivity, improving quality and lowering operating costs are all possible with Barden ceramic hybrid ball bearings. Why not learn from our experience? Contact your Authorized Barden Distributor for details or call Barden direct at (203) 744-2211 Ext. 468.

Applications

Applications where ceramic hybrids are highly recommended include:

Machine tools
- Grinding
- Milling
- Boring
- Drilling

Aircraft accessories/aerospace
- Generators
- Gyros
- Gearboxes
- APU's
- Turbine engines
- Radar
- Weapon systems
- Satellites

Industrial machinery
- Turbomolecular pumps
- Diesel fuel injection pumps
- Textile machines
- Woodworking machinery
- Food processing equipment
- Drilling equipment

Medical equipment
- Dental drills
- Centrifuges
- X-ray tubes

Features

60% lighter than steel balls
- Centrifugal forces reduced
- Lower vibration levels
- Less heat build up
- Reduced ball skidding
- Fatigue life increased

50% higher modulus of elasticity
- Improved spindle rigidity
- Naturally fatigue resistant

Tribochemically inert
- Low adhesive wear
- Improved lubricant life
- Superior corrosion resistance

Benefits

- Bearing service life is two to five times longer
- Running speeds are 50% higher
- Overall accuracy and quality Improves. Better workpiece finish characteristics
- Lower operating costs
- Boost productivity
- High temperature capability
- Cutting tool life is increased

For more information please contact your Authorized Barden Distributor. Outside Connecticut, call Barden toll free at 1-800-243-1060, Ext. 468. In Connecticut, call 744-2211, ext. 468

THE BARDEN CORPORATION
200 Park Avenue, P.O. Box 2449
Danbury, Connecticut 06813-2449
(203) 744-2211 FAX: (203) 744-3756